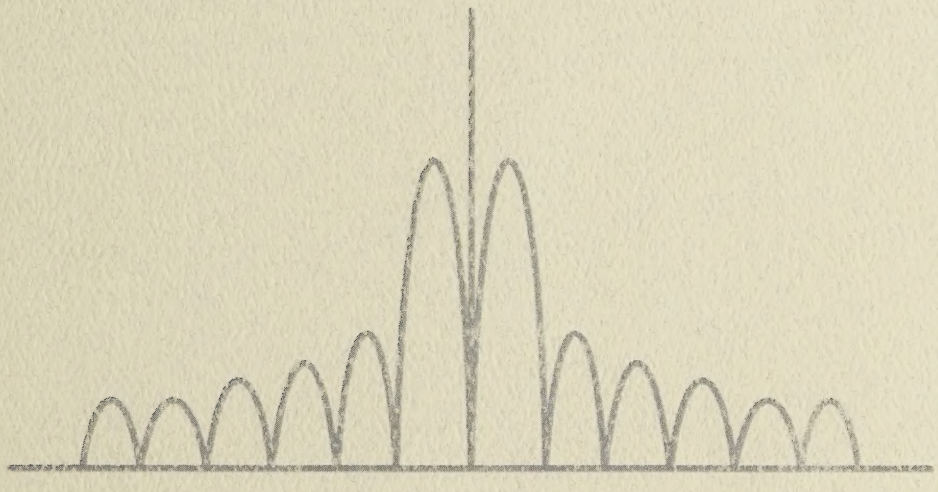
QF-1, QF-2
Audio Filter



Autek Research
Box 302
Odessa, Fla. 33556

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INSTRUCTIONS

QF SERIES AUDIO FILTERS

Your audio filter was fully tested before shipment. Please study the instructions below to obtain best results. If you require parts not supplied, please obtain these at a local radio store since we do not stock them.

A.INITIAL HOOKUP

Model QF-1. Plug the QF-1 into your receivers phone jack. Obtain an adaptor if size not compatible. Connect any impedance speaker or any high-impedance phone to output jack. To avoid hum or distortion with low-impedance phones, which are overly sensitive, use a series resistor. (See E.In Case of Trouble.) The QF-1 input may also be connected to the receiver speaker terminals. Be sure that the the cable shield (connected to the QF-1 chassis) is connected to the grounded speaker terminal. Otherwise, hum may be picked up. Note: This is rare, but a few types of CB radios and some Barlow Wadley radios require a resistor across their speaker or phone output; otherwise their audio outputs are not biased properly when connected to the QF-1 input. Try a resistor in the range of 10 to 100Ω.

ModelQF-2.The QF-2 should be initially checked out to familiarize you with operation before custom installing. Connect as shown in Fig. 1. See schematic/layout dwg. for leads. The QF-2 will not drive loads below 100 ohms directly without loss of volume. Use a matching transformer (Fig. 2) for low-impedance phones. The QF-2 does not have sufficient power to drive a speaker.

B. FAMILIARIZATION

An audio filter has an effect roughly analogous to a tone control on a Hi-Fi set, i.e. it filters signals you tune in on your receiver and selects or rejects frequencies you desire. Of course your filters response is much sharper and more flexible than a simple tone control to cope with Shortwave signals. There are three adjustments:

1. Function Select Switch.

   This switch selects (left to right) a peak, notch, or lowpass response. The peak (bandpass) function passes a narrow band of frequencies, while the notch function rejects a narrow band of frequencies. The peak or notch frequency is set by turning the frequency control. The lowpass function rejects high-frequency signals above the frequency set on the frequency control.

2. Selectivity Control (Pot). This control adjusts the width of the notch and bandpass response, and also affects the lowpass rolloff and notch depth. Bandwidths from as small as 40-50 HZ to essentially flat are available. The notch and peak widths are smallest with full rotation, but the notch depth decreases with more rotation (full clockwise=max. rotation). This control should not normally be rotated more than 60% except in "peak." Full rotation decreases notch depth and may lead to ringing in "lowpass."

3. Frequency Control (Pot). This control moves the peak, notch, and lowpass frequencies from approx. 250 Hz to 2500 Hz. This spans the entire range of useful communications frequencies. "Clockwise" rotation selects lower frequencies.

Note: Volume coming out of the filter is adjusted with your receivers audio control. Note that the filter retains its full selectivity regardless of source, load, or slight overdrive, i.e. no "impedance matching" is required except that some models have reduced output with loads under 100 ohms, as noted above.

C. USEFUL ADJUSTMENTS

Your filter is best adjusted by ear to match the prevailing conditions. Because of its numerous adjustments, you'll find that if it can't pull the signal out, nothing can. However, a few hours practice will be needed to learn its operation. The following table will aid you:

CONDITION	USEFUL ADJUSTMENTS
Desired CW Signal	Peak. Adjust selectivity near full Clockwise (CW). Peak desired station using frequency control. Use as much selectivity rotation as required for conditions. Note that maximum selectivity produces the highest gain at the peak.
SSB, AM, CB, FM, or broadcast station. No hetrodyne or whistle.	Lowpass. Rotate selectivity 10% CW or as far as possible without producing audible ringing (not critical). Turn frequency control for desired rejection of high frequencies. Note: greater than 50% rotation makes signals bassy, because important voice frequencies are rejected.
Hetrodyne, whistle, TV oscillator radiation (buzzing noise), or code station interfering with desired signal. Also for CB beats.	Notch. Rotate selectivity 40% or more. Adjust frequency control to reject undesired signal. Large selectivity rotations yield the narrowest and shallowest notch; also the hardest to tune. Therefore, rotate selectivity no more than required to avoid rejecting the desired signal. Note: to help find the correct rejection frequency, it may help to momentarily switch to peak, peak the interference, then switch back to notch. The peaked signal is then rejected. A slight frequency touchup may help since peak and notch frequencies may not track perfectly.
SSB, AM, CB, FM or broadcast station.	Under some conditions the following may also be useful: 1. Peak. Selectivity 20% to 60% rotated. Frequency adjusted for best clarity. Sometimes very useful. 2. Notch. Selectivity 0% to 30% rotated. Frequency 0% to 20% rotated. Produces an extremely sharp cutoff of high frequencies. If a hetrodyne appears, you can quickly turn controls as above. Preferred by many CB and 160, 80, and 40 meter operators for voice reception.
Weak CW	An AC voltmeter or scope across the speaker or phones is a big aid in peaking an extremely weak signal, especially if he fades below the noise occasionally. Also, you can pick up 10 db or so in moonbounce if you use PDI, a pen recorder, and send at 3-4 WPM! See below.
Strong signal	A "flat" response is obtained in: 1) Lowpass. Selectivity 10%. Frequency 0%. 2) Notch. Select. 100% Freq. 0%. 3) Peak. Select. 0%. Freq. 40%.

Other notes:

Full selectivity in peak is obtained only over the normal code reception range of 250 to 1300 Hz. Use less than 80% selectivity at high frequencies. Full selectivity in lowpass produces an effect similar to peak, but is not recommended because of reduced rejection of low frequencies. For use at a specific frequency above 1300HZ, align the filter at the desired frequency for best results. (see below)

D. CUSTOM INSTALLATION OF QF-2 (NOT FOR QF-1)

The simplest and surest way to use your filter is to connect as in Fig. 1, add a B+ on/off switch, and install in an external box. However, to obtain your receivers full speaker volume, or a compact result, the filter may easily be connected into your receiver (or transceiver) audio circuit.

Fig. 3a is the recommended method for most receivers. If hum pickup is a problem, connect to the top of the volume control ("b") or later in the audio circuitry ("c"). If audio output is distorted, you may have to use a higher B+ voltage to the filter (to 30 V), or experiment with the best connection point. Also, ensure that hum is not being introduced into the B+ line; if it is, use a larger filter capacitor. Be careful not to disturb DC bias conditions within your receiver audio stages; i.e. do not remove biasing resistors, connect the filter between direct-coupled stages, etc.. Be sure to connect filter ground or it will not work. To avoid hum, keep all leads close to chassis and away from power transformer. Note: D.C. Voltage at the filter input must not exceed 1000 volts, and ½ the B+ voltage at the output. B+ voltage must not exceed 30 volts. Do not exceed these limits or accidentally short to high voltage since instant burnout could result. This type of misuse voids the warranty.

If you have experimented with several installation points and need help you may write. You must enclose 1) A copy of your receiver audio stage schematic 2) A self-addressed stamped envelope. We do not maintain a schematic file, but will mark suggested installation points on yours.

B+ to the filter is easily obtained in transistorized rigs since these have low-voltage sources. The filter requires about 2/3 ma per volt, i.e. 6 ma. at 10 volt. In tube-only rigs with 6 or 12 volt filaments you can use a rectifier as in Fig. 4. If you have an AC/DC receiver, you must use a transformer/rectifier as shown in Fig. 5 to avoid a shock hazard. Fig. 5 is also suitable for use with any rig. Obtain parts locally. Or you may purchase a "9 volt battery eliminator" at a local store.

E. IN CASE OF TROUBLE

We test all filters several times before shipment. Most problems will occur when first trying the filter, and are usually due to improper connection (read instructions again) or misunderstanding of operation. The following are the most common:

HUM WHEN USING HEADPHONES: Hum generated in the QF-1 is normally barely audible with a speaker unless you place your ear within a few inches of the speaker. However, hum will be troublesome with low-impedance (e. g. 4 to 8 ohm Hi-fi type) phones. To cure this, connect a 47 to 100 ohm resistor in series with the phones.

HUM WITH SPEAKER: Usually this hum comes from your receiver. Pull the QF-1 input plug out of your receiver headphone jack and leave the plug resting on the table, disconnected. If the hum disappears, it is obviously being generated in your receiver and is not the fault of the QF-1. Check connections to your receiver headphone jack, and be sure that the QF-1 plug is making good contact. Jack and plug diameters vary slightly sometimes.

PICKUP OF YOUR TRANSMITTED SIGNAL: Numerous bypass capacitors are included to avoid pickup. It is extremely important that your rig, and the QF-1, be grounded to a good waterpipe ground to reduce RF. In stubborn cases, 1 mh. to 5 mh. RF chokes should be placed in series with the QF-1 input plug. A choke in series with the "inner" lead AND ground (shield) lead must be used. The rear panel terminal strip is a good spot for chokes. Plugging the QF-1 into an AC outlet away from the transmitter may also help. In stubborn cases, you may have to use a relay to open the speaker leads on transmit. (Never short the QF-1 audio output with a strong input signal applied as this may damage the output transistors after 60 seconds or so. Also, never feed a signal into the QF-1 output; only connect passive loads, such as a speaker, to the output.)

INSUFFICIENT AUDIO OUTPUT: The QF-1 audio output should be sufficient to fill a room to good volume; however, it will supply slightly less audio than most receivers, and will overload at lower volume level. Keep receiver volume lower than normal, especially on CW (full selectivity in peak) where the QF-1 gain is high. In cases where the output is extremely weak, suspect bad connections to the speaker, or a shorted QF-1 output jack.

BATTERY OPERATION OF QF-1 DESIRED: Connect a 9 to 12 volt battery to the positive (+) end of C106; the large 1000 uf. filter capacitor. Connect the negative end of the battery to the QF-1 case or headphone ground. Two wires may be run out the case for this.

F. WARRANTY AND RETURNS

WARRANTY: Your filter is warranted to the original purchaser to be free of defects in workmanship and materials for one full year. You must include purchase date (plus or minus one week) or other proof of purchase to qualify. You must also prepay shipping charges, and enclose $1.70 return postage in U.S.A., to avoid COD fees on the return. Warranty covers parts and labor. However, it is VOID if, in our opinion, the unit has been ABUSED, MISUSED, USED CONTRARY TO THE INSTRUCTIONS, OR MODIFIED IN ANY WAY WHICH MAY HAVE CONTRIBUTED TO A FAILURE.

Out of warranty, we can repair most problems for a $10 minimum service charge enclosed with the unit. If the charge is higher, we will inform you before proceeding.

You must enclose return postage and a DETAILED DESCRIPTION OF SYMPTOMS WITH ANY RETURNS. Especially be detailed about any intermittent conditions. Also, enclose any previous correspondence. Delays, and possible return of the unit without proper repairs may result if you don't follow these instructions.

DEALERS ARE NOT AUTHORIZED TO ACCEPT WARRANTY RETURNS. RETURN TO AUTEK, BOX 5127,SHERMAN OAKS, CA. 91403

G. CIRCUIT DESCRIPTION

Refer to the main board schematic. Op amps U1A, U1B and U2A, and associated circuitry, form a complete peak, notch, or lowpass circuit. Similarly, U2B, U3A, and U3B form an identical filter circuit. These two filters are connected in series for extremely sharp response, and tuned together with the dual frequency and selectivity pots, selected for their matched resistance characteristics. U4 supplies gain and some lowpass cutoff with capacitor C6.

Model QF-1 also includes an AC supply and audio amp. board. (See schematic.) The (2) rectifier diodes and 1000 uf capacitor form the B+ supply. U101 and resistors/capacitors to the left are an active lowpass filter which cuts off about 2500 Hz. U101 also drives the audio power transistors. Audio output is fed back to U101 (as much as 80 dB feedback) to cancel distortion. As a result, audio distortion below clipping is a small fraction of 1%, and much less than integrated-circuit audio output circuits sometimes used. The B+ voltage is designed to vary from over 14 v (no load) to about 11 v (full speaker volume) to about 7 v (shorted audio output). This action yields high voltage output into high-impedance phones, yet protects the audio output stage from a short circuit. The B+ may even be shorted with no damage, obviating the need for any fuse.

H. ALIGNMENT

The frequency of the second filter section is aligned to the first section by the trimpot on the main board between U2 and U3. This alignment is made before shipment and should not require further attention unless disturbed. Alignment requires a AC voltmeter, or oscilloscope. High impedance (600 ohms) headphones in series with a 1 uf, or larger, capacitor may be used if no voltmeter is available. Feed a sine wave at approximately 800 Hz (not critical) into the filter. Your receiver may be used for this purpose by tuning in a high-frequency whistle, calibrator beat note, etc. Select "peak" and rotate "selectivity" full clockwise. Connect the AC voltmeter to pin 10 of U1; this point is also connected to the selectivity pot, which is easier to reach. The correct pot lead is the one closest to the front (knob) end, and furthest to the right when viewed from the front end. Now rotate the "frequency" control to produce the strongest signal. Now, without changing frequency, connect the voltmeter to the filter output and rotate the trimpot with a screwdriver or by hand to peak the filter output. The second filter section is now aligned to the first.

I. SUPER-NARROW BANDWIDTH FOR MOONBOUNCE CW COMMUNICATIONS.

The filter bandwidth may be reduced to 10 Hz or less by reducing R4 and R9 to 20% of nominal. This is not normally recommended because oscillation may occur, good tracking is very difficult unless aligned near

the frequency of interest, tuning becomes touchy, and ringing becomes very apparent.

Another very useful technique is to use a pen recorder and post-detection-integration (PDI). This is similar to the technique used to receive radar echoes from Venus. See Fig. 6. The effective noise bandwidth of this scheme is approximately given by

$$B_{noise} = \sqrt{B_{IF}\, B_{PDI}}$$

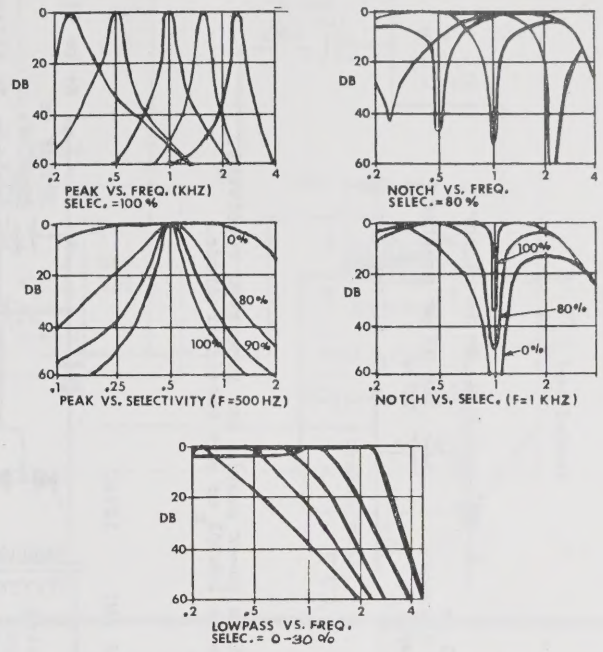
Where

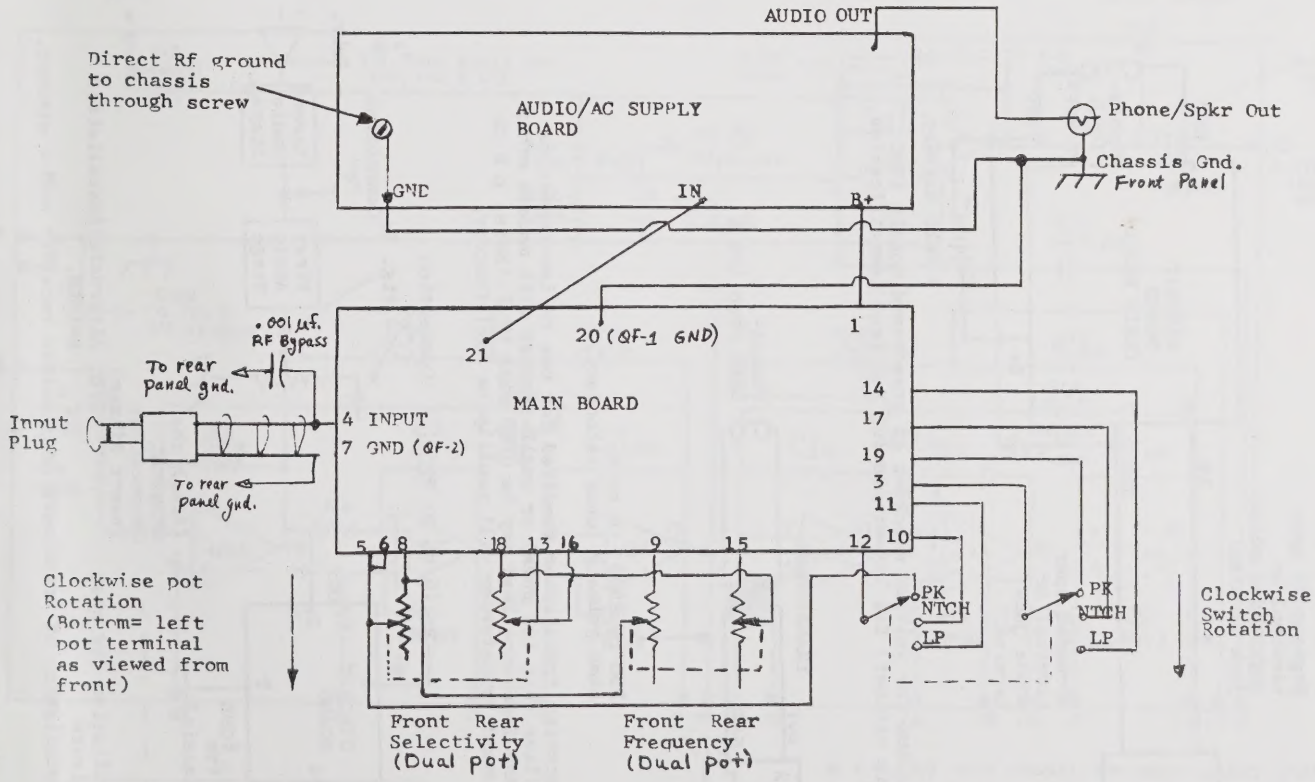
B_{IF} = effective IF bandwidth (50 Hz with QF filter)

B_{PDI} = PDI bandwidth $\approx 1/(6.28RC)$; R in ohms, C in Farads

For example, with RC=.32 seconds, then B_{PDI} = .5 Hz and the noise bandwidth is only 5HZ! This buys you 10 DB over a 50 Hz bandwidth! There are penalties, however. For one you can't hear a signal this weak with your ear. Thus, the QSO must be planned, and the frequency must be tuned quite accurately, but only within the IF bandwidth (50 Hz), not within the 5 Hz noise bandwidth. Also the length of the shortest code character (code "dot") should be no longer than RC. This means sending must be slow--about 3.5 WPM for the example.

A FEW OF THE INFINITE NUMBER OF RESPONSES





QF-1 Board Hookup. Note: Wiring to selectivity pot, frequency pot, and switch is identical for QF-2. For QF-2 input, output, ground, and B+, see figs. 1 to 3. For both models, see Main Board layout drawing to identify physical position of numbered connections.

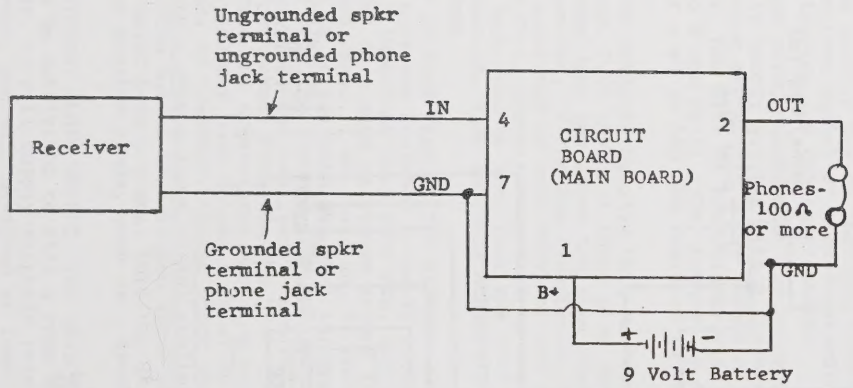


Figure 1. Hookup for initial checkout of breadboard models (Not for models in cabinet) See layout drawing for lead identification.

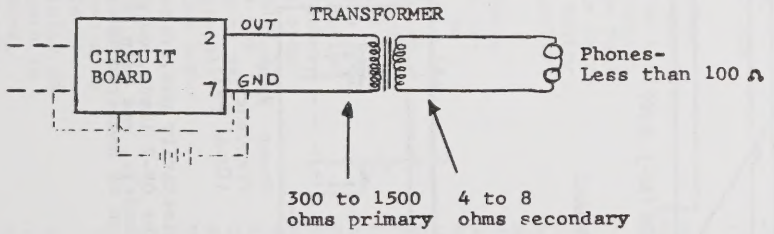


Figure 2. Matching transformer required for use of low-impedance headphones (less than 100 ohms) or small speaker with models other than QF-1.(Any impedance load may be used with QF-1.) Note: A 6 to 12 volt filament transformer will usually be satisfactory.

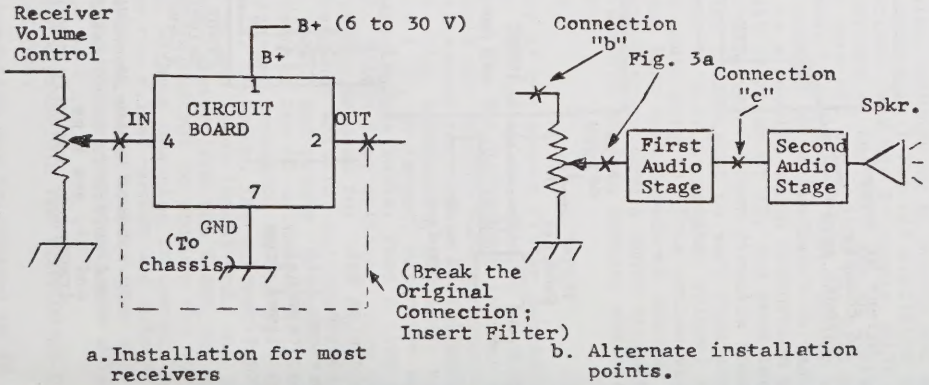


Figure 3. Installation of breadboard models into receiver audio circuit.

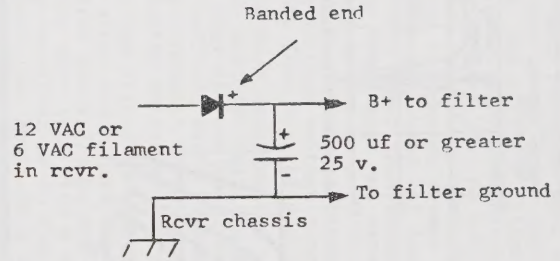


Fig. 4. Possible power supply for tube-type receivers. Diode is 1N4001 or any rectifier diode.

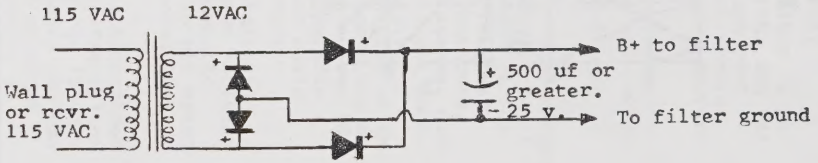


Fig. 5. Power supply for any rig. Diodes are 1N4001 or any rectifier diode.Better than Fig. 4 because of increased voltage output and reduced ripple, although more expensive and much larger.

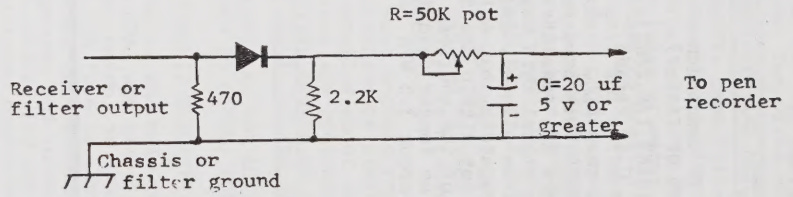
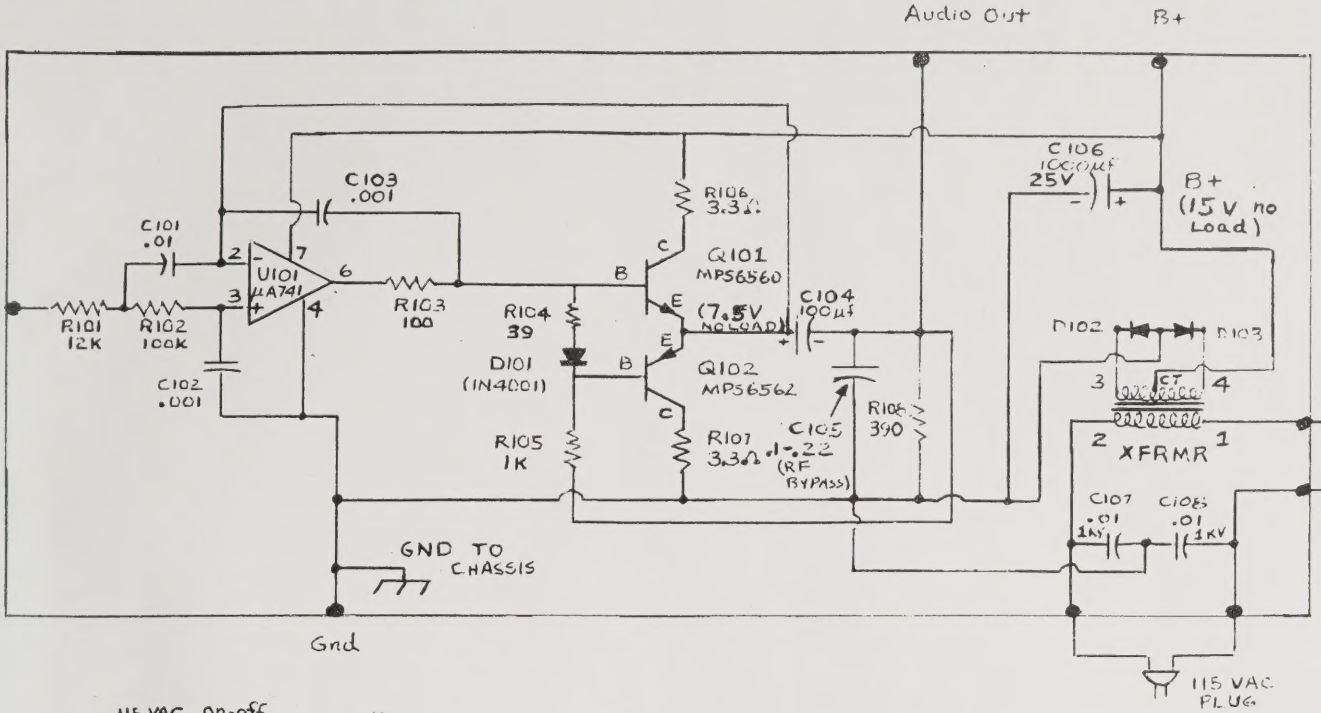
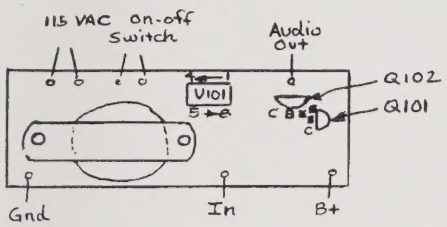
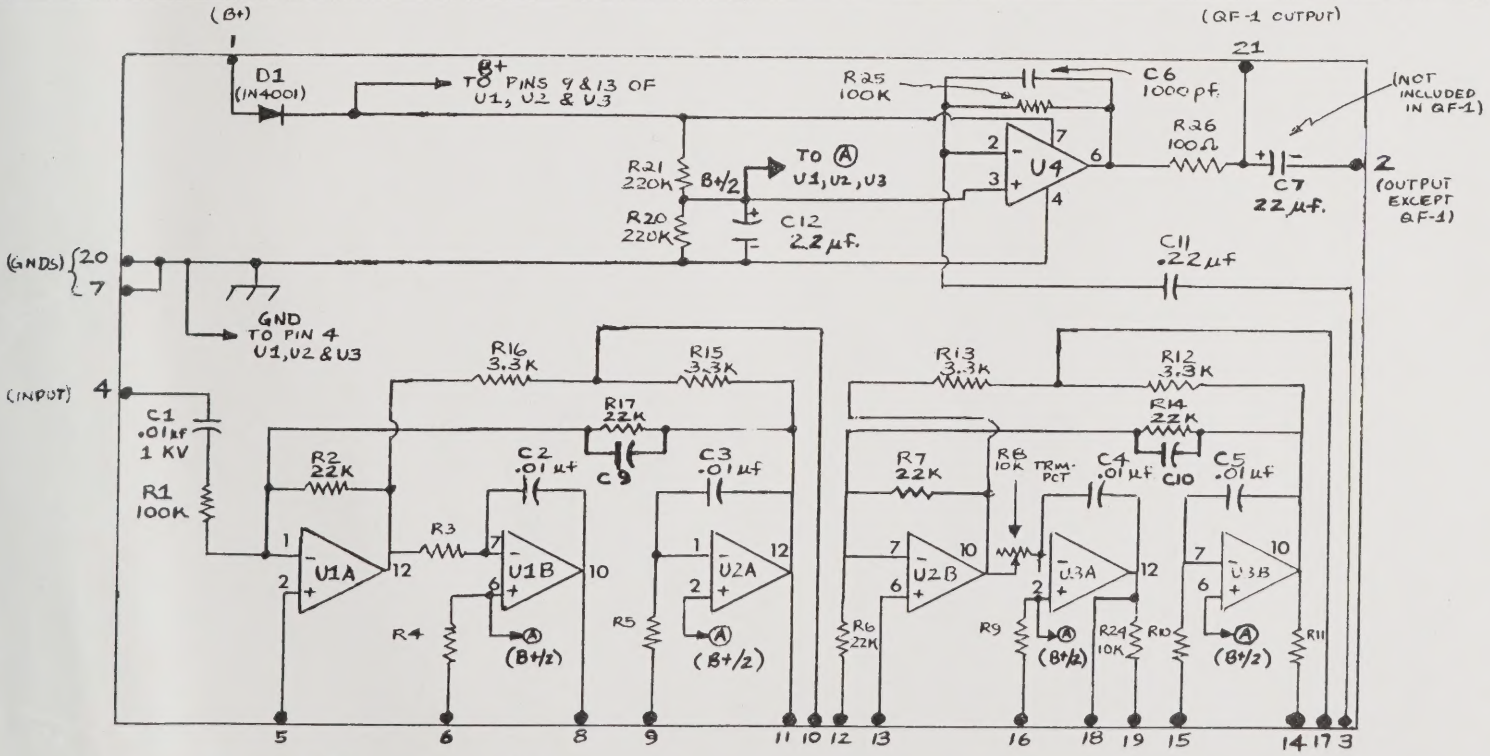


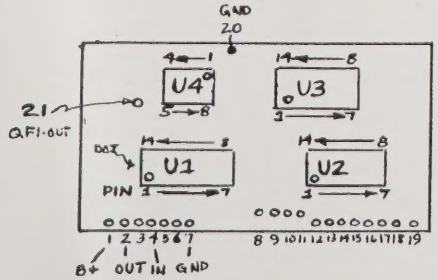
Fig. 6. Use of post-detection-integration (PDI) for super-narrow CW moonbounce communications. Diode is 1N4001 or any rectifier diode. Note: Maximum RC= 50000 ohms x 20 x 10^{-6} farads= 1 second





QF-1 FILTER
AUDIO PWR AMP/AC SUPPLY BOARD





PHYSICAL LAYOUT. (CIRCLES = INPUT/OUTPUT CONNECTION LOCATION)

NOTES:
0) R4 & R9 are chosen to match select. pot.
1) R3, R5, R10 & R11 Chosen to match C2, C3, C4 & C5. Typical value is 3.3K to 6.8K.
2) C2, C3, C4 & C5 matched to 1%.
3) U1, U2 & U3 = µA747 ; U4 = µA741

QF FILTER
MAIN BOARD
SCHEMATIC/LAYOUT DRAWING